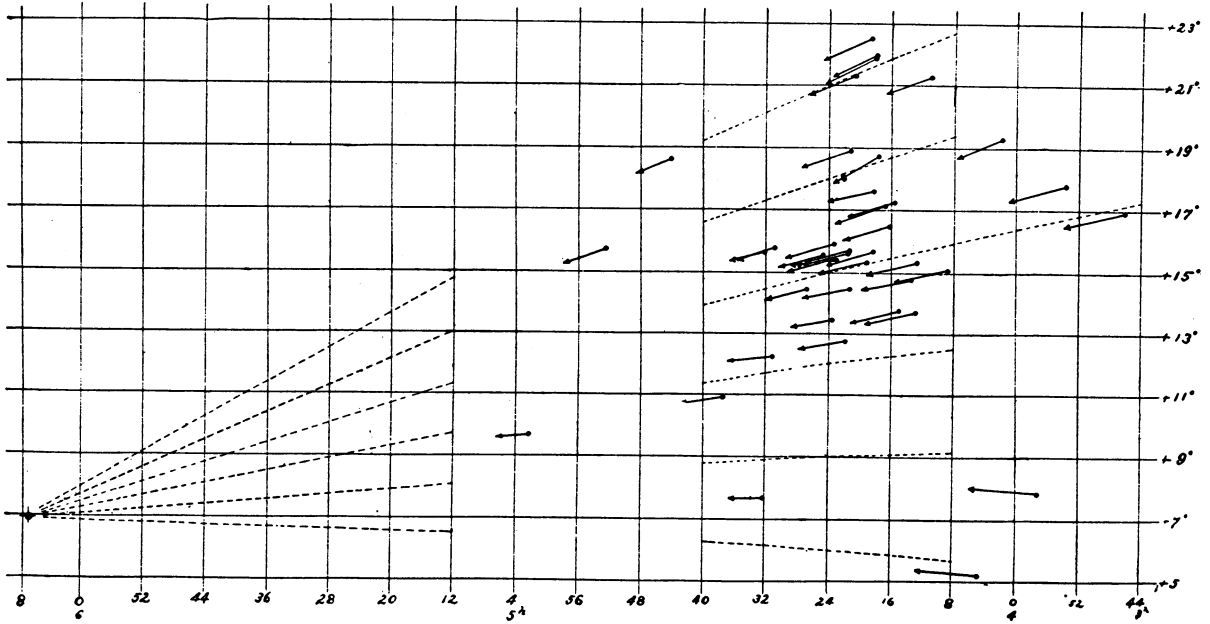

STAR-STREAM IN *TAURUS*.

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A REMARKABLE STAR-STREAM IN *TAURUS*.

BY W. W. CAMPBELL,

It is well known that many rather widely separated stars possess proper motions,—i. e., motions at right angles to the lines joining the stars and observer,—of essentially the same magnitude and direction; as, for examples, certain stars in the "Big Dipper," and the majority of the stars in the *Pleiades* cluster.

In a recent issue of the *Astronomical Journal,* Professor Boss, of Albany, announced and discussed a most remarkable case of this nature, embracing about forty stars of magnitudes 3½ to 7, in the constellation *Taurus*. Certain of the stars near the center of the group engaged Professor Boss's attention as long as twenty-five years ago, in that their proper motions were seen to be nearly identical. The recent completion of his "Preliminary General Catalogue" of the positions and proper motions of the brighter stars enabled him to recognize thirty-nine, and possibly forty-one, stars whose directions of motion converge to a common but distant point, and whose speeds are such that they will apparently arrive in the vicinity of the converging point simultaneously.

The accompanying illustration expresses the main facts more forcibly than words can do. The present positions of the stars are given by the round dots, and their speeds and directions of motion are indicated by the arrows drawn from the dots. It will be seen that these stars form a widely extended cluster, about 15° in diameter,[1] with marked central condensation;

[1] The right ascensions, extending from 3h 44m to 6h 8m, are given along the bottom of the chart, and the declinations, +5° to +23°, along the right edge.

that they are all (with two possible exceptions) aiming approximately for the point of convergence at the left edge of the charted region; that those furthest to the right have in general the largest proper motions; and that with the progress of time the cluster will become more and more condensed.

It should not be concluded that the component stars of the scattered cluster are really approaching each other, as their motion toward the converging point seems to suggest. Professor Boss's discussion leaves essentially no doubt that the stars are moving along parallel lines; and as these lines extend further and further into space, they appear to unite at the converging point. The lengths of the arrows represent the motions that will occur in the next fifty thousand years. By virtue of the increasing distances of the stars from us, their apparent motions will decrease with time, so a period of sixty-five million years, more or less, will be consumed in traveling to the vicinity of the vanishing point (never actually reaching it), at which time this group would "appear as a globular cluster about 20′ in diameter, and constituted largely of stars of magnitudes 9 to 12, with a well-marked central condensation." The direction of motion is necessarily one of recession from the observer, for the stars are approaching the vanishing point. The direction of motion in space is inclined 27°.5 to the line drawn from the observer through the center of the cluster.

Professor Boss notes that the stars in the cluster, moving with equal speeds in parallel lines, should have nearly equal speeds in the lines of the observer's sight: a certain average speed for the stars nearest the center of the cluster; related higher speeds for those nearer the radiant; related lower speeds for those further from the radiant; and, if the speed of any one star in the group be observed by means of the spectrograph, the corresponding speeds and parallaxes of all the stars in the cluster may be computed. The spectrographic velocities of three stars in the group have been measured and published by Professor KÜSTNER:—

γ *Tauri*.....	$+39.6^{km}$	per second.
δ *Tauri*.....	+40.8	" "
ϵ *Tauri*.....	+39.4	" "

From these Professor Boss has computed the speed of the entire group of stars to be 45.6^{km} per second toward the vanishing point; and the average parallax of the group to be 0″.025.

Inasmuch as the extreme outer stars of the group are separated by 15°, their minimum distance apart must be greater than one fourth (15/57.6) the distance separating us from the group,—that is, the most widely separated stars in the group must have a mutual parallax less than four times 0″.025, or 0″.1. Professor Boss reminds us that more than thirty stars of those nearest to our Sun have parallaxes exceeding 0″.1. The vast space through which these thirty stars are extended has a diameter only twice the minimum diameter of the space in which the stars in the cluster under discussion are distributed. It is difficult to account for the origin of such a widely separated group of stars, traveling with equal speeds along parallel lines.

It should be noted that some 15^{km} of the observed speed of recession of the cluster is due to the recession of the solar system away from the cluster.

About seventy-five other stars in the same region, brighter than the seventh magnitude, do not have the distinctive proper motions of the cluster, and are consequently not connected with it.

Nine of the cluster stars have been observed with the Mills spectrograph of the Lick Observatory, as follows:—

Star.	No. of Obs.	Dates.	Velocities.	Remarks.
γ *Tauri*	6	1897–1908	+ 35.8 to + 40.0	Probably variable of long period.
δ *Tauri*	6	1899–1907	+ 38.0 to + 38.8	
κ *Tauri*	2	1904	+ 12 to + 44	Poor spectrum; small weight, perhaps of variable velocity.
68 *Tauri*	3	1905–1908	+ 34 to + 36	
υ^1 *Tauri*	1	1904		Very poor lines.
ϵ *Tauri*	6	1898–1906	+ 40.6 to + 37.8	
θ^1 *Tauri*	4	1905–1908	+ 37 to + 38	
θ^2 *Tauri*	6	1903–1908	+ 17 to + 80	Binary.
c Tauri	3	1905–1908	+ 45 to + 66	Measures of 1 line only. Suspected binary.

Six of these stars have velocities in good agreement with the requirements of the cluster theory, and the other three

stars, two of which have spectra with poorly defined lines, afford no evidence in opposition to this theory.

The spectra of twenty-three other stars in the same region of the sky have been observed with the Mills spectrograph, but none of them show speeds in the vicinity of $+ 38^{km}$, with the possible exception of two or three having variable velocities.

THE NORTHERN LIMIT OF THE ZODIACAL LIGHT.[1]

By E. A. Fath.

The boundaries of the zodiacal light are hard to determine because of the faintness of the phenomenon, although the light along the axis is quite strong and can be seen even in cities in spite of the electric illumination. From the usual observations of the boundaries of this light we should expect the light to extend about 20° to the north and south of the Sun. That the zodiacal light is of much greater extent is evident from the observations described below.

In the summer of 1907 Director Campbell, of the Lick Observatory, called the writer's attention to a faint light, which for years has been seen in the summer by various observers at Mount Hamilton, extending along our northern horizon near midnight, and asked that an attempt be made to determine its character. Observations were accordingly begun and continued during the summer of 1908.

The general appearance of the phenomenon when observed near midnight, with a clear sky and no Moon, is that of a flat arch of light with its maximum intensity near the north point of the horizon. At that time of night in the early part of July, 1908, the greatest altitude above the northern horizon was 18°. It extended westward about 40° and eastward to the Milky Way, and was symmetrical with respect to the meridian. At the extremities it was only a degree or two above the horizon, depending on the clearness of the air at such a low altitude. When, however, the observations were

[1] For a complete account see *Lick Observatory Bulletin*, No. 142.